INFRA INSULATION

ACCORDION • CRINKLE • KRAFT • ASBESTOS

Insulates against Heat, Condensation, Vapor, Vermin, Mold and Fire

Manufactured by **INFRA INSULATION, INC. • 10 MURRAY STREET, NEW YORK, N. Y.**

CARTON

3½′ x 1½′ x ½′ = 3 cu. ft.
contains 1000 sq. ft.
weighs 60 lbs., 1 oz. to sq. ft.

•

Comparison with ordinary Insulation

Weight—60 lbs. against 3000 lbs.
Cu. ft.–3 against 175.
Cartons–1 against 25
C factors stamped on each carton

TYPE 4 ACCORDION INSULATION

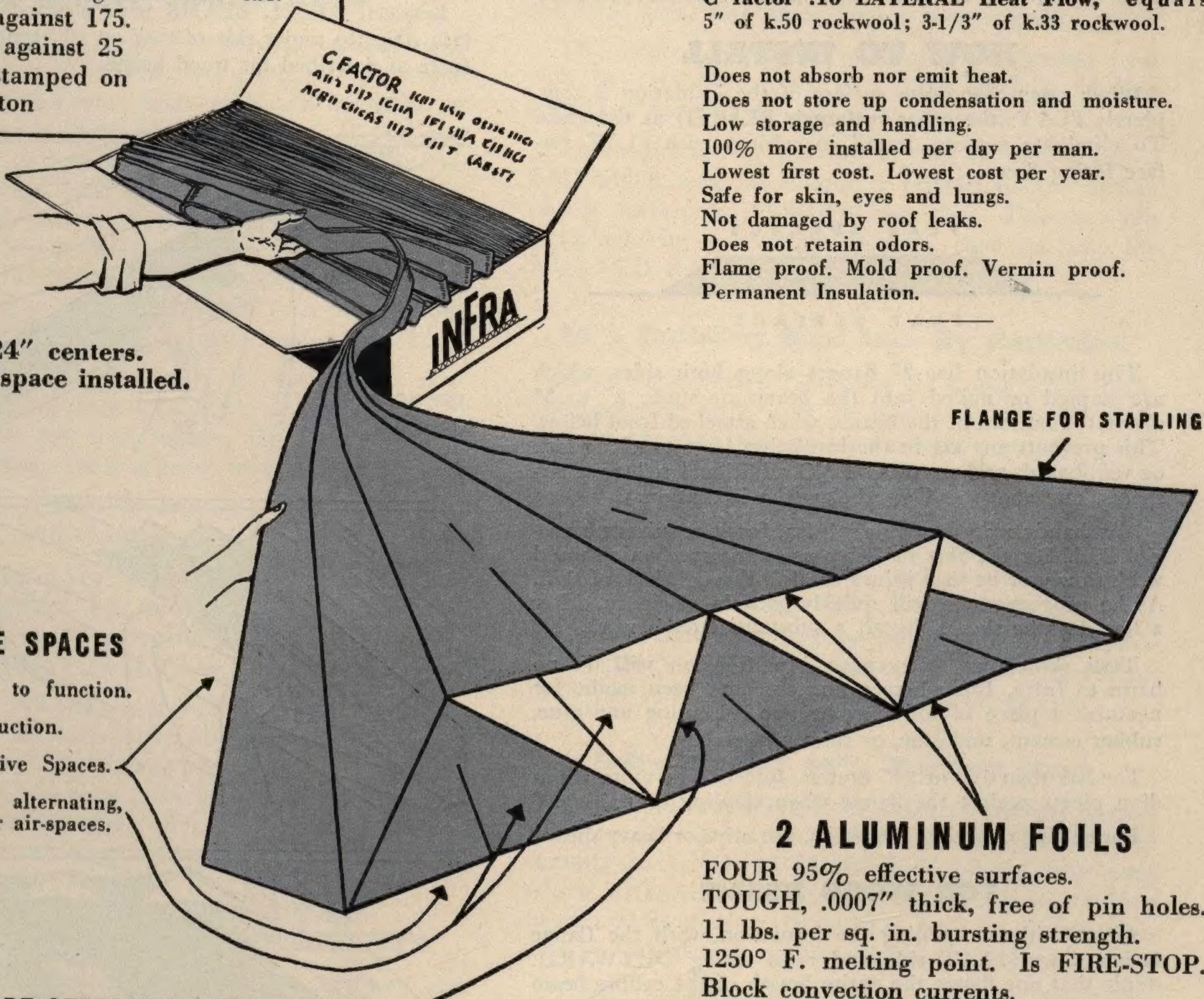
Aluminum and Triangular Air-Cells

C factor .052 DOWNWARD Heat Flow, equals 9-3/5″ of k.50 rockwool; 6-1/3″ of k.33 rockwool.

C factor .083 UPWARD Heat Flow, equals 6″ of k.50 rockwool; 3.97″ of k.33 rockwool.

C factor .10 LATERAL Heat Flow, equals 5″ of k.50 rockwool; 3-1/3″ of k.33 rockwool.

Does not absorb nor emit heat.
Does not store up condensation and moisture.
Low storage and handling.
100% more installed per day per man.
Lowest first cost. Lowest cost per year.
Safe for skin, eyes and lungs.
Not damaged by roof leaks.
Does not retain odors.
Flame proof. Mold proof. Vermin proof.
Permanent Insulation.



**For 16″ and 24″ centers.
Occupies 1½″ space installed.**

4 REFLECTIVE SPACES

Enable aluminum to function.
Slight Conduction.
2 Outer Reflective Spaces.
2 rows of inner, alternating, reverse, triangular air-spaces.

ACCORDION FIBRE SEPARATING FOUNDATION

Creates 2 inner rows of 1½″ reflective spaces.
Makes BOTH inner foil surfaces 95% effective.
Enhances CONFIGURATION FACTOR.
Blocks inner Convection currents.
Prevents foil from touching foil.
Flame, mold and vermin-proof.

2 ALUMINUM FOILS

FOUR 95% effective surfaces.
TOUGH, .0007″ thick, free of pin holes.
11 lbs. per sq. in. bursting strength.
1250° F. melting point. Is FIRE-STOP.
Block convection currents.
Impervious to water vapor. 700% to 2600% resistance of insulation paper.
Too light for condensate accumulation.
DUST or dullness does not affect them.
PERMANENT — Will not deteriorate.
COLD SURFACE — Emits 5% heat rays.
WARM SURFACE — Rejects 95% rays.

ACCORDION TYPES

Infra Insulation is competitive in price with ordinary insulations.

Consist of pure aluminum, and 2 rows of alternating, reverse, triangular, reflective air-spaces. Occupy 1½″ space. Non-laminated aluminum, .0007″ thick, with bursting strength of 11 lbs. per sq. inch (Mullen Test.) Spacing foundation is either permanently flame, mold and vermin proof KRAFT, "K" line; or ASBESTOS, "A" line.

4K, 4A: 4 reflective air-spaces; FOUR 95% efficient, heat-ray rejecting surfaces. 2 foils of tough .0007″ foil.

2K ACCORDION: TWO reflective and TWO non-reflective air-spaces. Flat outer sheet is tough .0007″ aluminum with TWO 95% efficient heat-ray rejecting surfaces. Peak outer sheet is TOUGH 45 lb. KRAFT. Kraft base.

4KL, 4AL: *RECOMMENDED where one outer surface of insulation is to remain exposed.* 4 reflective spaces. FOUR 95% efficient reflecting surfaces. Flat outer sheet consists of 2 foils reinforced with central core paper lamination to withstand abusive handling. Peak outer sheet is tough .0007″ aluminum. Kraft or Asbestos foundation.

(U. S. Patent Nos. 1,757,479; 1,890,418; 1,934,174; 2,015,817; 2,101,856.)

HOW TO INSTALL

When open, one outer surface of the insulation is completely FLAT; the other surface is PEAKED at the ends. To eliminate sagging, install in ceilings with FLAT surface facing down.

PEAK SURFACE

FLAT SURFACE

This insulation has 2″ flanges along both sides, which are stapled or nailed into the beams or studs, 2″ to 3″ above the bottom of the beams, when attached from below. This prevents any sag in the insulation from touching lath or wall-board, and provides TWO additional reflective air-spaces, one above and one below the insulation.

Any handy man can install Infra, for it requires no special skill. For the first half day or so the mechanic should work slowly or he may injure the foil through lack of skill. As he progresses, he will quickly gain in efficiency. After a few days he should install a substantial day's work.

Tests show that an occasional perforation will do no harm to Infra. But where a puncture has been made, for neatness a piece of foil may be applied, using any glue, rubber cement, mucilage, or silicate of soda.

For less than 16″ or 24″ centers, fold one or more accordion pleats against the flange when stapling or nailing.

For cutting or fitting insulation, use snips or heavy shears.

FOR WOOD BEAMS

First: Without opening the insulation, with the flange facing down, FLAT side and mass facing OUTWARD; staple that one flange the entire length of the ceiling beam or wall stud. *See Illustration Step No. 1.*

(When installing in walls, it is best to either flatten the insulation at both ends; or extend it about 1″ at right angles and staple onto ceiling and floor. Nothing elaborate.)

A staple every 5″ or 6″ will suffice. The use of an automatic stapling hammer makes for low cost installation.

After the entire length of one flange has been stapled, the insulation should be opened in the following way. The unstapled flange is grasped at one end by BOTH hands (hands stretched 3 feet apart), and pulled open. *See illustration No. 2.* This prevents tearing of foil, and provides opportunity for ample stapling where opened.

The process of pulling open and stapling the second flange 3 feet at a time is continued until the opposite beam is also completely stapled.

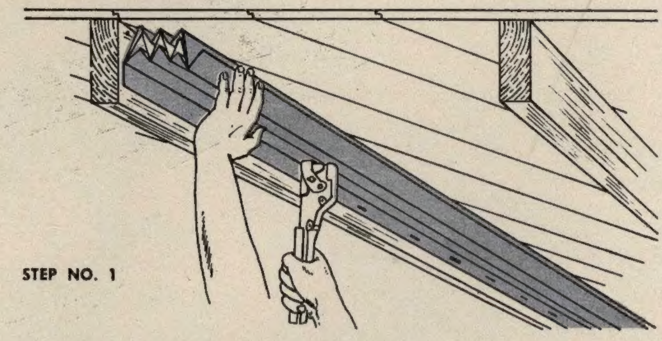
When stapling the second flange, one hand should push the surface of the insulation away from the flange, to make room for hammer swing. *See Illustration Step No. 3.*

NOTE: We can furnish suitable automatic stapling hammers and staples.

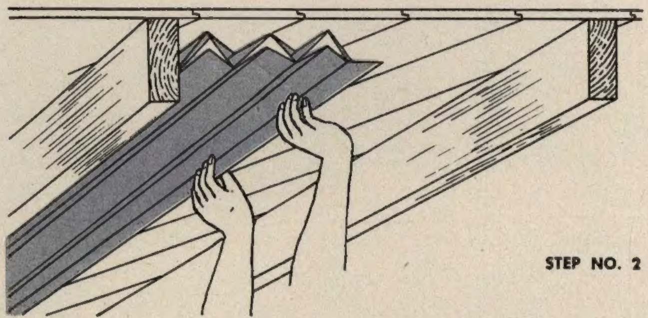
STEEL BEAMS and TRUSSES

For TRUSSES the same procedure is followed as for wood beams; except that Infra is LAID on wires strung between the trusses, and the FLANGES of 2 parallel blankets are then CLIPPED together with a stapler.

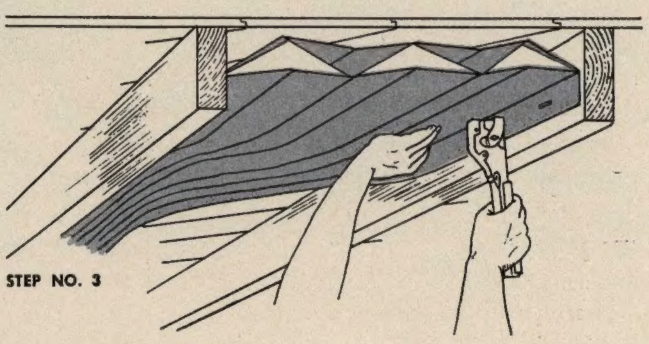
Between STEEL BEAMS with a wooden roof, attach lath strips to under side of roof on 16″ centers, and staple Infra as described for wood beams.



STEP NO. 1



STEP NO. 2



STEP NO. 3

SIMPLIFIED PHYSICS of THERMAL INSULATION

by Alexander Schwartz, President Infra Insulation, Inc. (Copyright 1947)

TYPE 4 INFRA

"C" FACTOR IS .083 FOR UP HEAT FLOW!

—*Why?*—

Infra Insulation's Resistance to heat-flow encompasses ALL THREE methods of heat transference, —CONDUCTION, RADIATION, CONVECTION.

The flow of heat, except for wind currents, is ALWAYS from the hot surface to the cold surface; NEVER the other way. The function of all thermal insulation, whether fibrous or reflective, is to prevent heat from escaping or entering a structure.

ONLY SLIGHT CONDUCTION

CONDUCTION is heat flow *through* matter, and results from actual PHYSICAL CONTACT, either of one part of the same body with another part, or of one body with another. For instance, if one end of an iron rod is heated, the heat travels by Conduction in that same body throughout the metal to the other end; and also to the immediate surface of surrounding air which is another but less dense body. A well-known instance of Conduction through contact between 2 solid bodies is the heat that passes into a cooking pot laid on the solid surface of a stove.

The more dense a substance, the better it is as a conductor. For instance solid rock, or glass, or slag, or all minerals for that matter, being very dense, are excellent conductors of heat, and poor insulators.

Reduce their density by mixing air into the mass, and we reduce their Conduction.

Because air has a very low density, *"The percentage of heat transferred by conduction through air is comparatively small."* ("See Building Insulation", 3d Edition, page 104, Paul D. Close*.)

Since Infra Accordion Insulation consists mainly of four series of air spaces, and two foils each of whose thickness is 7/10,000th of an inch, whose separating medium is a thin piece of paper; heat flow by CONDUCTION through Infra Accordion Insulation is slight, compared to more massive substances.

RADIATION AND REJECTION SLIGHT ABSORPTION & EMISSIVITY

Most rays are invisible; a few are visible and are known as Light. The existence of the invisible ultraviolet and infra-red rays is now fairly well known to the public as well as to scientists. The small range of visible rays, such as yellow, orange, green, blue, violet, has always been known.

RADIATION, whether from the sun, a stove, a radiator, a human being, a floor, a ceiling or roof, or from any warm object, is the process by which rays are transmitted through SPACE.

WHEN they strike the SURFACE of an object, these rays are generally ABSORBED, and then HEAT is engendered in the object. This heat spreads throughout the mass by Conduction. By far the greatest amount of heat is engendered by the infra-red heat rays, with their longer wave-lengths.

The heated object then transmits infra-red heat rays by radiation from ITS other surface, if that surface is exposed directly to an air space.

This *radiation* or starting of flow of rays is called EMISSION, and its extent is related to the ability of the surface to ABSORB heat rays. The rays not absorbed by a surface which they strike, are TURNED BACK, *reflected* back, rejected.

70% Building Heat Loss By Radiation

In order to retard heat flow by Conduction, walls and roofs are built with air spaces. As a result, Conduction through this air space which has *some* but slight density, and Convection currents, combined, is only 20% of the heat which passes through it.

All authorities are in agreement that up to 80% of the heat that passes through such a space from the warm wall to the colder wall, is radiant heat.

Paul D. Close says on page 106 of "Building Insulation" that *"such radiant heat transfer may vary"* *"up to 70 per cent or more in the case of air spaces."*

Infra Rejects 95% Radiant Heat

The aluminum surfaces of Infra Insulation possess the scientific quality of NOT ABSORBING but of turning back, REJECTING, 95% of the heat rays which strike them. This 95% refers only to radiant heat, and is distinct from heat flow by Conduction and by Convection, which processes still go on.

These aluminum surfaces of Infra Insulation TRANSMIT by Radiation but a negligible percentage of any heat actually absorbed, whether absorbed by any or all of the 3 methods; the actual EMISSIVITY being 2% to 5%. *(1947 Heating, Ventilating, & Air-Conditioning Guide, page 106.)*

* *Mr. Close was Technical Secretary of Insulation Board Institute and previously Technical Secretary of the American Society of Heating and Ventilating Engineers. Publishers: American Technical Society, Chicago, U. S. A. Price $4.50.*

1/18th Emissivity

The Emissivity of some materials whose surfaces do not appreciably reject infra-red rays, for instance that of paper, or roofing paper, wood, glass, rock and slag, shows that such materials have Absorption and Emissivity ranging from 90% to 93%. *(Authorities, Profs. Wilkes and Peterson of Massachusetts Institute of Technology and E. Schmidt; see 3d Edition of P. D. Close's book "Building Insulation", page 101).*

The 1947 edition of Heating, Ventilating and Air-Conditioning Guide, page 106, gives asphalt and paper an Emissivity of 90% to 98%.

Bright aluminum paint, whether applied to paper, wood, brick or other substances, has a radiant heat Absorption while it lasts of up to 60% INDOORS, (40% efficiency against Radiation), and up to 50% for direct solar radiation OUTDOORS. *(1947, Heating, Ventilating, Air-Conditioning GUIDE, page 106.)*

A genuine aluminum surface, OUTDOORS, has a radiant heat Absorption of 10% up to 40% (or 60% to 90% radiant efficiency) for direct solar radiation; compared to 5% Absorption, or 95% efficiency INDOORS. *(1947 HVA Guide, page 106).*

The reason for this difference between indoors and outdoors is that in addition to the infra-red rays, the sun emits other rays, visible and invisible, which also engender a certain amount of heat when they strike and are absorbed by a surface; for instance the outer surface of the roof or wall of a building. Most of the radiant heat so absorbed and engendered is Emitted by the inside surface of the roof or wall as invisible, infra-red heat rays; not as visible color rays.

Dr. J. L. Finck, director of the Finck Laboratories, New York, formerly with the U. S. Bureau of Standards, stated in the Jan. 1935 issue of THE ARCHITECTURAL RECORD, *(we can furnish copies.)*

> "As a matter of fact, practically all materials used in building construction,—brick, stone, wood, paper, and so on,—regardless of their color to visible light, are over 90 per-cent black for infra-red radiation. Therefore, air spaces within building walls are bounded by materials which are good absorbers of the radiation which impinges upon them."

FHA Tech. Circular 7, Jan. 1947, page 18, states: *"The ordinary surface has an emissivity of .90".*

Each of the 4 aluminum surfaces of Infra Accordion Insulation has at most 5% against such 90%, or 1/18th the radiant heat *absorption,* and 1/18th of the Emissivity or ability to transmit heat rays, of these mentioned and similar substances.

Reflection In Space

Reflection and Emissivity by surfaces, however, can take place ONLY in SPACE. The ideal space is *any* dimension OVER three-quarters of an inch (¾"), although smaller spaces are also effective, but decreasingly so, with NO EFFECTIVENESS where there is no air space. On the contrary, we then have heat flow by Conduction through solids.

If a reflective surface of a material is attached to a ceiling, floor or wall, that surface of the material ceases to have radiant insulation value. Hence in order to function, aluminum surfaces must be bounded by air spaces. But even where this is not always practicable because of space or structural limitations, Infra Insulation is so constructed that its accordion foundation CREATES two rows of INHERENT, triangular, alternating, reflective air-cells, which not only ENHANCE its insulating value, but PREVENT FOIL FROM TOUCHING FOIL with its resulting Conduction.

Cold Surface Also Effective

In Close's book, *"Building Insulation", 3d Edition, page 102,* we find the following phenomenon:

> "As far as the rate of heat transfer across an air space is concerned, it makes NO DIFFERENCE whether the reflective surface is on the COOLER or warmer side of the space."

One aluminum foil in the CENTER of an air space creates 2 reflective air spaces and thereby has TWO efficient reflective surfaces, regardless of the direction of heat flow. For upward heat flow, this combination gives the unusual efficiency of the equivalent of over 1" of laboratory-dry rockwool. To obtain still better results, additional reflective surfaces and air spaces must be added and created.

In Type 4 Infra Accordion Insulation we have FOUR such reflective surfaces; in 2 outside and 2 rows of inside reflective air-spaces; all resisting the flow of heat with slight Conduction, slight Absorption, and slight Emission.

1 Surface in 1 Space

Another important phenomenon is that a second aluminum surface bounding the SAME air space has practically NO insulation value. ONE aluminum surface in an air space is 95% to 98% efficient against heat rays, leaving a maximum potential of only 2% to 5% for a second surface. Infra Accordion insulation has only ONE aluminum surface in each air space, and so ALL FOUR of its aluminum surfaces are 95% to 98% EFFECTIVE.

RETARDS CONVECTION

CONVECTION is the THIRD METHOD of heat-flow. A good example is the rising of air heated and expanded by contact with the surface of a warm radiator, or heated air flowing from a grille.

The outer aluminum surfaces of Infra Accordion Insulation, which are NON-POROUS and have no permeability, plus the inner fiber foundation which bounds the 2 rows of triangular air-cells, OBSTRUCT the flow of heat by Convection.

There is also heat flow by *Conduction* between air which has so risen, and the insulation which it touches. But the Emissivity of Infra Insulation's aluminum foil is so LOW, and the Conduction of its air-cells so slight, that Conduction because of contact of *convected,* blocked air, with foil, is also minimized.

There remains then the heat flow by *Convection* WITHIN the air spaces of Infra Insulation itself. When heat by outside Convection reaches the outer surface of the insulation, there is a certain amount of Conduction between the Convected, heated air; the foil; and the air immediately bounding the inside surface of the foil. This inside surface of air then moves diminished heat by Convection which is again blocked by the fibrous foundation in the center.

The process of Absorption and Emission of heat rays, and Conduction through to the next inside surface of air again takes place, with further diminished Convection in the next air-space to the last foil.

Here the entire refining process of Reflection or Rejection of heat rays, refusal to Absorb and transmit the rays through low Emissivity; plus diminished Conduction, again take place.

Finally there is further diminished Conduction through the last outer air space.

In their book *"INSULATION", Dalzell* & *McKinney** state on page 29,

> "Thermal insulation with a metal is made possible by taking advantage of the low thermal emissivity of aluminum foil and the low thermal conductivity of air. It is possible with this type of insulation practically to eliminate heat transfer by radiation and convection".

CONFIGURATION FACTOR

The SHAPE and relative POSITIONS of the various *surfaces* and *air-spaces* WITHIN Infra Insulation play very IMPORTANT parts in enhancing its insulation value.

The TRIANGULAR shape of the air-spaces in *alternating*, REVERSE rows; their DISTANCE apart; the *accordion* SHAPE and TEXTURE of the fibrous foundation; ALL play their important part in enhancing Infra insulation value.

Physicists and Engineers call this, "The Configuration Factor". (*See page* 103, 1947 *HVA Guide.*)

On page 113, *the* 1947 *HVA Guide states*:—"The Conductance of an air space is dependent on the temperature difference, the height, the depth, the position and the character of the boundary surfaces. The relationships are not linear and accurate values must be obtained by test and not by computation."

FOILS VARY 2000%

Many foils as manufactured have high Absorption and high Emissivity qualities. The variations run from 2% to 72%, with a differential of over 3000% (See Building Insulation, page 101, P. D. Close).

Infra Insulation uses only specially prepared foil, made in accordance with Infra specifications. It has the lowest Absorption and Emissivity, and is impervious to water vapor and Convection currents.

We now see why Infra Type 4 Accordion Insulation, with its Configuration factor; with its FOUR reflective surfaces, EACH with 95% heat ray REFLECTIVE or REJECTING power; each with only 5% heat ray ABSORPTION and EMISSIVITY; with its 3 effective, Convection surface-stops, two of them made of non-porous, non-permeable aluminum foil; and with its four series of reflective air spaces which are virtually NONCONDUCTORS; has such low Conductance and such high Resistance factors for upward heat flow.

"C" FACTOR .052 FOR DOWN FLOW

WHY? Because there are no Convection currents. Heated air, being lighter, rises when it is displaced by heavier, colder air. *In Vol.* 31, *page* 824 *of INDUSTRIAL AND ENGINEERING CHEMISTRY (we can furnish copies on request)*, *Dr. J. L. Finck states*:

> "Let us now consider the heat transfer between two plane parallel surfaces. If the surfaces are horizontal, with the hot surface over the cold surface, there will be no convection, only conduction and radiation. In all other positions we will have all three modes of heat transfer."

So while the performance of Infra is amazing for upward or winter heat; for downward or summer heat, because of the absence of Convection currents it has an ADDED efficiency. The hot sun is hurled back outdoors, keeping the building COOL.

If in addition Infra Insulation is ALSO installed in the ground floors and crawl spaces of cold buildings, it will prevent the heat rays from penetrating down; reflect the heat back into the house where it belongs; and also create FOOT COMFORT.

INFRA DISCLOSES THERMAL FACTORS

Infra Insulation Inc. considers the matter of thermal values so important that it incorporates the factors of its insulation in all Infra literature, and STAMPS ON EVERY CARTON OF INFRA INSULATION THE THERMAL FACTORS OF ITS CONTENTS.

CONDENSATION, HUMIDITY, VAPOR

In winter, when the heated air strikes the cold wall or ceiling, condensation often occurs. It also occurs in summer if the climate is very humid, or with evening drops in temperature.

The University of Illinois, Small Homes Council, in Circular F6.2 on "MOISTURE CONDENSATION" states: *"Condensation becomes a problem to the homeowner when it occurs ON OR WITHIN THE WALLS AND CEILINGS."* It also states: *"Excessive moisture can cause a variety of undesirable conditions, only some of which are visible. In northern areas, this moisture condensation may result in water-spotted walls, ruined painted jobs, ROTTED LUMBER."* (Written Jan. 1947 by F. B. ROWLEY, director University of Minnesota Experiment Station. *We can furnish copies on request).*

When the condensation is absorbed by insulation, it diminishes the Resistance to the flow of heat and increases the Conductance of the insulation, because water is a good conductor and a poor insulator.

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* *J. Ralph Dalzell, B.S., Head Architectural and Engineering Dept., and James McKinney, Educational Director of American School. Publishers, American Technical Society, Chicago, U.S.A.*

In Close's 3d *EDITION* of *"BUILDING INSULATION"*, page 96, we find: *"Moisture increases the rate of heat transfer through a material, because water, which fills the pores or voids, conducts heat more rapidly than air."*

Dalzell and McKinney, in their book, *"INSULATION"*, state on page 4: *"Moisture greatly reduces the effectiveness of insulation."*

PROF. GORDON B. WILKES of the Massachusetts Institute of Technology wrote on June 19, 1936, (*we can furnish copies on request):*

"Many insulating materials become better conductors of heat with an increase of the relative humidity due to the absorption of moisture by the insulator. Practically all of the published data, concerning co-efficients of thermal conductivity are based on 'bone dry' conditions, a situation that is never met in practice. Aluminum Foil is one of the few insulating materials that is not affected by humidity and consequently its insulating value remains unchanged from the 'bone-dry' state to high humidity conditions."

"If conditions are such that water vapor does condense on the surface of the foil, only a thin layer could form on vertical or inclined surfaces because the remainder would immediately drain away. With the usual 'fill' type insulation, condensed water vapor would tend to spread by capillary action and would be held in the insulation itself."

In "INDUSTRIAL AND ENGINEERING CHEMISTRY," Vol. 31, page 824 (*we can furnish copies on request*), Dr. Finck wrote:

"In considering the heat flow through a fibrous mass, the boundaries between the fibers and the surrounding air must be considered. Even though the conduction along the fibers may be large, the thermal resistances offered by the air films reduce the over-all conduction considerably. What, then, happens when moisture penetrates the fibrous mass? If this moisture is absorbed by the fibers, leaving the surfaces of the fibers dry, the effect of the over-all conduction will be slight. However, if enough moisture is added so that the surfaces of the fibers are wet, the contacts between the adjacent fibers are fused by the water, and the previous high-thermal-resistance air contacts are replaced by low-resistance water contacts. The over-all conduction is greatly increased. Other materials, such as oil, resin, asphalt, cement, have the same effect as water."

22% Less Efficient

The following tests by the College of Engineering, University of Detroit are in point. To quote:

"Heat Transfer Tests on Samples of Home Insulation. These tests were made on a sample 3 feet by 3 feet in size and 3⅝ inches thick (thickness of a finished 2 by 4 stud piece) in a Guarded Hotbox tester as standardized by the American Society of Heating and Ventilating Engineers. The results are:

"Test 1. Samples 3⅝ inches thick, 40 lb. Brown Kraft paper boundary on each side and good grade of mineral wool filling the interior space. Tested with hot box dry (Low Humidity).

Density of mineral wool, lbs. per cu. ft. 7.96
U Thermal transmittance, (overall) BTU per hr. per sq. ft. 0.0895
R Thermal Resistance, R=1/U 11.17
Mean temperature, deg. Fah. 84.1

"Test 2. Sample as above. Tested with hot box saturated WITH VAPOR

U Thermal transmittance, (overall) 0.116
R Thermal Resistance 8.62
Mean temperature, deg. Fah. ...... 85.4"

The difference in Thermal Resistance was .228, or over 22% REDUCTION IN INSULATION VALUE.

NO HEAT NOR MOISTURE STORAGE

Infra does not merely slow up temporarily the escape of valuable heat in winter. Nor does it encircle the house with a hot blanket in summer.

In his June 19, 1936 paper (*we can furnish copies on request*) PROF. G. B. WILKES of M.I.T. stated:

"Due to its light weight, the heat storage capacity is very low and consequently, a wall or roof, insulated with aluminum foil will tend to reach thermal equilibrium with the surroundings quicker than one insulated with the heavier types of insulation. Under summer conditions with a falling temperature at night after a hot day, the roofs and ceilings of a house insulated with foil will tend to cool more rapidly than if they were insulated with heavier materials. The reverse is also true, a foil insulated structure will tend to heat quicker than one insulated with the ordinary types of insulation."

On September 11, 1946, PROF. WILKES wrote:

"It has been my experience that condensation has been minimized with aluminum foil insulation compared with other types. I have reflective insulation under the floor of my home and have had no trouble over a ten year period."

The ABSORPTION of heat rays of most surfaces, including the surfaces of fibrous materials and of the paper which sometimes encloses them is 90%.

The Emission of accumulated heat by heat rays from the same surfaces is 90%.

Dalzell and McKinney, in their book "INSULATION" say about aluminum insulation on page 29:

"Practically none of the heat is stored up"; aluminum insulation "reflects it immediately. Therefore the supplied heat immediately heats the air in the house, instead of heating up the structure itself. This naturally results in warming the house more quickly on winter mornings, and at a low fuel cost.

"Conversely, in hot, summer weather," aluminum insulation "reflects the sun's heat from the house and keeps it comfortable. It does not retain stifling daytime heat all during the night. When nighttime coolness arrives, the insulation temperature immediately drops and the house becomes cool at once. This is because it has no heat storage capacity."

They also state that aluminum insulation "does not store heat, is not harmed by wetting, is fireproof, does not swell or warp, and can be used where temperatures rise as high as 1250° F."

Exchange of Heat

On Sept. 10, 1946, PROF. CARL F. BOESTER of PURDUE UNIVERSITY wrote this about Infra:

"Because of the extremely low thermal capacity of your material, it is next to impossible to have any condensation occur and certainly not in any quantities to be measurable, to say nothing of any chance of condensate accumulation."

To the technical mind, the reason for the above is simple. Condensation is related to the DENSITY of the material per cubic foot. For vapor to condense and moisture to precipitate, there must occur an EXCHANGE of HEAT. Heat that has been supporting vapor in the air is surrendered to the material on which the condensation occurs.

By multiplying the specific heat of a material by its weight, and, of course, taking into consideration its temperature, the amount of energy available for HEAT EXCHANGE is determined.

It is obvious that Infra with its ONE OUNCE per square foot has VERY LITTLE THERMAL CAPACITY, and therefore there is very little chance for much condensation to occur; so little in fact as to be almost difficult of observation. There would be absolutely no chance for cumulative effect.

By the nature of its structure, Infra can NOT form, absorb nor STORE appreciable moisture. It does NOT consist of multitudinous, tiny fibers, each bounded by condensation forming surfaces; nor of myriads of small sponge-like cells for condensation and moisture as well as heat absorption. In justice to the building you are constructing, give it dry walls.

FUNGI CAUSE TIMBER ROT

Mr. E. V. Condon, director of the National Bureau of Standards, in the foreword of report BMS 106 *(for sale by Supt. of Documents, Wash., D. C., price* 10*c*) issued Aug. 2, 1946, on "Laboratory Observations of Condensation in Wall Specimens," states:

"Condensation may destroy the efficiency of insulation and shorten its life; it may also cause rot in timbers".

Dalzell and McKinney in their book "INSULATION" state on page 255 and 256:

"It is accepted that the most generally destructive agency confronting the builder and owner is rot or decay in lumber or timbers used in construction.

"Decay of wood is a biological process caused by the breaking down of the wood substance of living fungi,—they require an adequate food supply, suitable temperature, and particularly, a satisfactory moisture condition, not too wet or too dry.

"When a seed or, as it is called, a spore of the fungus falls on a piece of wood or other suitable food and proper conditions of moisture and temperature prevail, it germinates, sending out a microscopic thread which penetrates the wood. Growth is by the repeated branching of this thread which pushes its way in all directions in the wood. The spores (or seeds) are always microscopic and can withstand long periods of dryness and cold. They are easily carried about by air currents and, because of the wide distribution of wood, are found in abundance in all communities. In the vast majority of cases, untreated wood will become infected, and decay will set in when the right conditions of moisture and temperature are present.

"The most important single factor influencing the decay of wood,—assuming it to be infected, is its moisture content. Perfectly dry wood decays slowly, if at all."

Infra also eliminates the hazard of damage to walls due to possible freezing and expansion of accumulated moisture. Kitchen vapors, or water in any form, even from roof leakage, will not adversely affect alumimum, nor diminish its emissivity and reflectivity. Neither will the salt sea; nor fumes; nor dust; nor occasional perforations and punctures, as experience and tests show. *(See U. S. Bureau of Standards tests in Technical Bulletin* #38, *issued by the National Housing Agency, on the subject of perforations, condensation and vapor.) We can furnish copies on request.*

700% AND BETTER, VAPOR BARRIER

Aluminum foil is the ideal VAPOR BARRIER. As PROF. WILKES states in his paper of June 19, 1936, *(we can furnish copies on request)*:

"Metal foil is impervious to water vapor as compared to other types of insulating materials so it would be more difficult for the water vapor to penetrate into the insulation."

During the latter part of the war, machinery, foodstuffs, in fact almost everything shipped across the ocean was wrapped in aluminum foil to protect it from moisture, heat, sun, cold, frost, dust, rust, fumes, dryness, salt sea air, etc.

The Resistance of aluminum foil to vapor transmission, or its *permeability rate,* ranges from .085 to .129; while that of "treated insulation backup paper" ranges from .66 to 3.42. *(Authority L. V. Teesdale, U. S. Dept. of Agriculture, Forest Products Laboratory. See page* 250, *Building Insulation, by Close.)*

The superiority ranges from (740%) Seven Hundred Forty Per Cent to Four Thousand Per Cent.

VENTS OR LOUVRES NOT REQUIRED

Since Infra Insulation is vapor proof and practically free from condensate accumulations, vents are not required over it. Where vents or louvres have been installed, they should be closed in the winter time.

The use of vents or louvres applies only over fibrous insulations to help them try to get rid of their inevitable accumulations of winter condensation.

The University of Illinois, Small Homes Council, in

Circular F6.2 on "MOISTURE CONDENSATION" states: *"If insulation is placed on the upper floor ceiling and EFFICIENT vapor barriers are properly installed, attic ventilation is not necessary except to remove summer heat."* (Written Jan. '47 by F. ROWLEY, director University of Minnesota Experiment Station. *We can furnish copies on request).*

A COMPLEX PROBLEM

BOWDOIN COLLEGE, MAINE, confronted with a serious insulation, heating and condensation problem, installed Accordion Aluminum Insulation. Later, *Prof. Noel C. Little* of the Dept. of Physics wrote:

"Our problem was to heat occasionally a small building too distant to be reached by the College's central heating system. The walls of the building were a single thickness of solid construction; the roof, but 3/4 in. boards covered with galvanized iron sheeting. During the winter months moisture would condense and freeze on the floors and the paint on the walls and ceiling would mildew with the dampness. In summer, on account of the thin roof, the building was intolerably hot.

"The insulation has completely eliminated the moisture and condensation difficulty. Temperature measurements, taken at the hottest time of a sunny summer day, showed the inside directly under the roof to be some 8° cooler than the shade outside.

"Calculation of the heat losses indicated that, even with zero temperatures outside, it should be feasible to heat the building with electricity. Expectations were realized in practice. Our heating system now consists of a bank of electric light bulbs placed in front of an electric fan. Even in midwinter, when the building has not been used for several weeks, it is possible with this arrangement to attain a comfortable temperature within a reasonable time. A throw of a switch in the afternoon insures a classroom ready for use in the evening with a cost of about 15c.

".97 kilowatts maintained a temperature difference of 23 degrees centigrade between inside and outside after an essentially steady state had been reached. Approximately 96% of the heat is held back in the room."

INFRA RAYS PENETRATE DUST. DULLNESS

INFRA-RED HEAT RAYS are dissimilar from light rays, such as are reflected in a mirror. Light rays can penetrate only glass, or other transparent or translucent substances. Infra-red rays penetrate dust, moisture, and are absorbed by plaster, wood, brick, iron, etc. But aluminum surfaces TURN BACK these heat rays where there is a proper kind of air cell. This kind of reflectivity has no relationship to the brightness of the foil, which is JUST AS EFFECTIVE WHEN DULL as when shining bright.

The National Bureau of Standards, U. S. Dept. of Commerce, in its Letter-Circular-535, states:

"Installations are reported where no appreciable deterioration of the aluminum has occurred over a considerable period of years. Thin layers of dust readily visible to the eye do not cause any very serious lowering in the reflecting power. The appearance of the surface is not a reliable guide as to its reflectivity for radiant heat, and foil which appears dark or discolored may have lost little in insulating value if the surface film is thin."

Prof. Gordon B. Wilkes of the Massachusetts Institute of Technology states as follows, in a booklet entitled, *"Thermal Test Coefficients of Aluminum Insulation for Buildings"*, (*we can furnish copies*):

"A mirror, consisting of glass with a silvered surface on the back of the glass, is an excellent reflector of light but it is a very poor reflector of infrared radiation corresponding to room temperature. In fact, such a mirror would have about the same reflectivity for infrared as a coating of black paint.

"With this in view, it is obviously impossible to judge the infrared reflectivity or emissivity of a surface by its appearance to the eye. Consequently, in a discussion of reflective surfaces for building insulation, the term brightness has no specific meaning. The terms emissivity or reflectivity definitely define the radiating or reflecting power of a surface and values may be determined for the long wave-length radiation corresponding to room temperature."

In his June 19, 1936 letter, (*we can furnish copies on request*), Prof. Wilkes says:

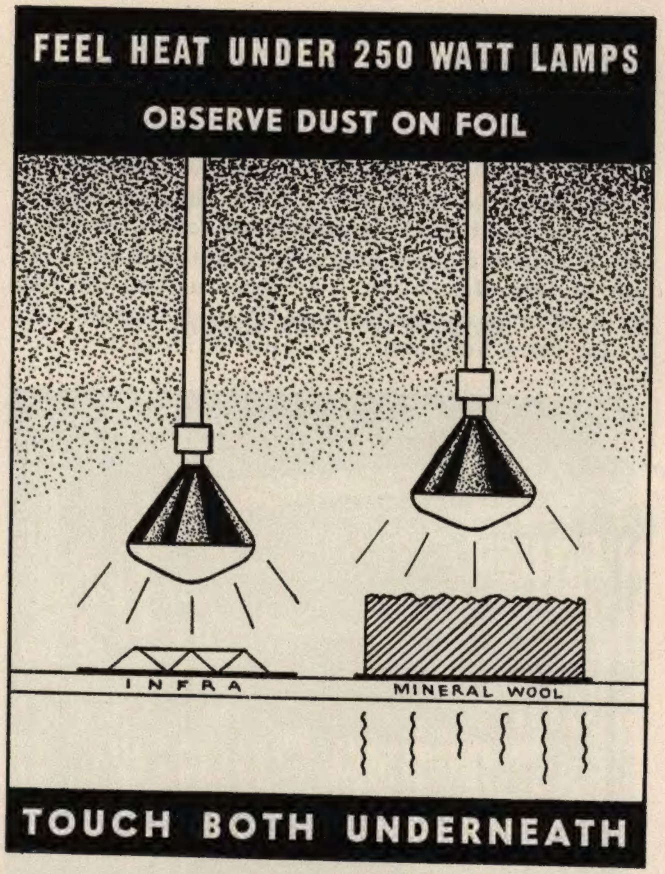
"Several samples of Aluminum Foil Insulation, that have been exposed to the air and dust of the laboratory from five to seven years show no appreciable deterioration in insulating value and there are also on record numerous cases where aluminum foil has been removed for examination after from five to nine years service and found to be practically unchanged in insulating value."

In Close's book, "BUILDING INSULATION," 3d Edition, page 109, we find: *"The visible brightness of a surface is not a gauge of its emissivity, for a surface may appear to have lost its reflective value and yet have a comparatively low emissivity as tested by a radiometer or emissivity-testing instrument."*

The only thing that adversely affects aluminum is actual contact with WET lime. By installing the insulation deep in the joist or stud, not only is contact avoided, but an additional air space is formed to enhance the value of the insulation. Another solution is to use Type 2 Infra, with paper facing the plaster.

In the April 1947 Home Show at the Grand Central Palace, New York City; sponsored by the Home Builders Council of New York, New Jersey and Connecticut, during a period of 8 days over 50,000 people saw and participated in the following simple experiment, which anyone can perform in his office or home.

Suspended in mid-air was a 6" long, 16" wide strip of Type 4 Infra Accordion Insulation, with an accumulation of dust. Also suspended alongside was a 6"x16" strip of full thick mineral wool blanket, vapor-barrier paper facing down. 2" above each insulation was a 250 watt electric heat bulb.



Undersurface of INFRA remains comfortably cool to the touch under more than 250° of heat during 12 hour daily test.

Undersurface of full-thick mineral wool becomes uncomfortably warm to the touch during test and remains so for a long time afterward.

ELECTRICITY

Along with the *whispering campaign* about "dullness", "dust", "tarnishing", and other "bogies", is the misstatement about aluminum foil and troubles with "electrical contacts", "static" and "lack of grounding".

The Federal Government recently contacted many important radio manufacturers. Not one radio firm had ever experienced any of these difficulties. The government then accepted Infra Insulation.

Prof. Gordon B. Wilkes of the M.I.T. wrote Infra as follows on September 11, 1946:

"In my opinion, the question of static, electrical contact and grounding is of no importance. I have known of a great many houses insulated with aluminum foil and have yet to hear of any trouble from lack of electrical contact or grounding. This question was raised over ten years ago by competitors of aluminum foil insulation but no authentic case of trouble from this cause has ever been brought to my attention."

Many millions of feet of aluminum insulation have been installed in structures for the past 30 years, here and abroad, with no electrical disturbances.

Leland Hubbell Lyon, architect, New Rochelle. N. Y., wrote on Jan. 15, 1947:

"I have never heard of any electrical trouble caused by foil insulation. The thought in itself seems very foolish to me because no question of electrical contact is raised when wire lath is used as a plaster base. Wire lath, as you know, is far heavier than the foil and could therefore make a better conductor. How about water, heating and gas piping which conductors often cross and parallel? Electrical conductors are supposed to be insulated from all outside contact, otherwise trouble would arise with or without insulation.

"In my opinion the use of a foil type insulation has no effect on the electrical wiring system of a building."

FIRE-PROOF, MOLD-PROOF, VERMIN-PROOF

The kraft paper used in the "K" line is absolutely flame-proof, mold-proof and vermin-proof. It is not just dipped into the chemicals, nor sprayed. The chemicals are mixed INTO the pulp at the time the paper is manufactured, making them an integral part of the paper. It is further protected by aluminum.

Since aluminum has a melting point of 1250° F., higher even than that of asbestos which is 750° F., the kraft or K line of INFRA is also a FIRE-STOP.

PERMANENT IN THERMAL VALUE

Aluminum is PERMANENT in insulation values.

Only 99.6% PURE ALUMINUM is used in the manufacture of Infra Insulation.

Prof. Wilkes stated in his June 19, 1936 paper *(we can furnish copies on request)*:

"In regard to the permanency of the reflective surface, I have no hesitancy in stating that under proper installation conditions, Aluminum Foil Insulation will maintain its efficiency over a long period of time when used as building insulation."

In the American Society For Heating & Ventilating Engineers' *Journal Section, Jan.* 1940 *(we can furnish copies on request)* Prof. Wilkes stated:

"Aluminum foil exposed in a vertical position since 1929 to the dust and fumes in the Heat Measurements Laboratory, M.I.T. Samples of this foil have been removed from time to time and the emissivity determined. Over a period of 10 years no appreciable change in emissivity was found."

"Aluminum-foil-insulated provision chambers of the motorship Leverkusen, fitted out in May, 1928. In January, 1934, samples of this foil were removed by representatives of Lloyd's Register of Shipping, Hamburg; they reported: 'The general impression gained as a result of the examination made is that the insulation examined by us is in exactly the same condition as it was five years ago when built into the vessel.'"

"Hundreds of samples of aluminum foil have been stored in the laboratory for various periods of time up to 10 years with no visible signs of deterioration of the surface."

Inherent weight, especially when accentuated by condensation and water, can cause fibrous insulation to bog down and lose some of its insulation value.

In their book "INSULATION", Dalzell & McKinney state on page 4:

> "Volume dimensions, however, offer a more serious problem, because many loose insulations settle down year by year, producing areas that are eventually without insulation. Thus, it is best to use molded forms of insulation or other forms not likely to settle or change in volume."

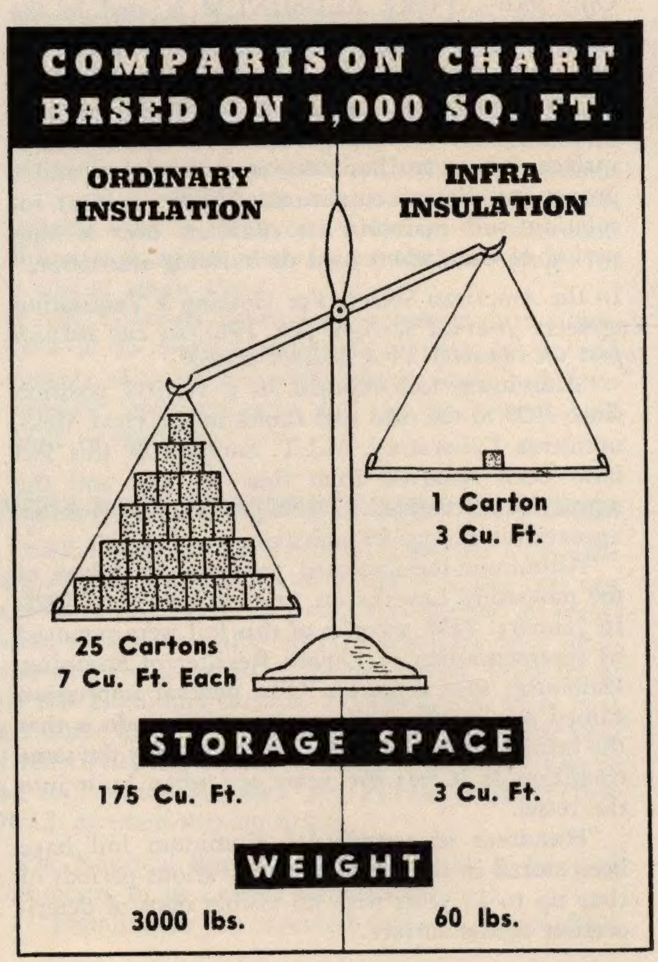
Infra is so light that once installed, it stays put, and retains PERMANENTLY its insulation value.

The foil extends throughout the flanges, so that the staples anchor the insulation through the foil as well as the paper, rendering the insulation as permanent as the building itself.

Infra is constantly light in weight, winter, summer and under all conditions of humidity; less than one ounce to the square foot.

2% WEIGHT, STORAGE & CARTING SPACE

Infra is packed compactly, 1000 sq. ft. in each carton, about 3½′ x 1½′ x ½′, or *3* cubic feet; *which a man can easily carry under his arm* since it weighs under 60 lbs. Large quantities can be stored in a small space; one million sq. ft. in a carload, or in a room 16′ x 16′ x 12′.



1000 sq. ft. of ordinary insulation weighs about 3000 lbs. Infra 60 lbs.; a ratio of about 50 to 1.

1000 sq. ft. of ordinary insulation requires 25 cartons to handle and carry, against 1 carton for Infra.

Each of the 25 cartons of ordinary insulation contains 40 sq. ft. and is over 7 cu. ft., against 3 cu. ft. for 1 carton of Infra Accordion Insulation. EACH of the 25 cartons is more than twice as bulky as the 1 carton of Infra Insulation. The space needed for 1000 sq. ft. of ordinary insulation is 175 cu. ft., against 3 cu. ft. for Infra Accordion, or a ratio of 58 to 1.

This man is carrying under one arm, in one trip, one carton, weighing 60 lbs., containing 1,000 square feet of Infra Accordion insulation. With ordinary insulation he would be required to carry 25 cartons, each one heavier and over twice as bulky, weighing 2000 lbs. to 4000 lbs. in all.

ECONOMICAL

Infra cartons are so small and handy that a man going to work can take 8,000 sq. ft., 8 cartons, and tuck them away even in a passenger car, thereby eliminating trucking, waste of time in not having material available, and spoilage and loss on a congested project.

No supporting foundation, such as wire, furring strips, backer-board, lath strips, etc., is required to keep Infra from tearing away at the staples. These entail added expense. Stapling alone suffices to hold Infra in place, because it weighs LESS THAN ONE OUNCE TO THE SQUARE FOOT.

Infra's light weight and compactness keeps down the cost all along the line, in transportation, handling, labor, storage, etc.

Also, the efficiency of Infra should be a definite factor in determining upon the size of furnace, oil, coal or gas, that will be needed to meet the heating requirements of a building, with definite economies in the initial as well as fuel consumption costs.

INFRA FOIL IS TOUGH

Infra is TOUGH. A special aluminum foil is used, .0007″ thick, which has a bursting strength, (Mullen test) of 11 lbs. per sq. inch. (Most aluminum foils are only .00035″ to .0005″ thick).

SANITARY: Safe for Eyes and Lungs

Infra is ALWAYS sanitary. It does NOT provide a cozy nesting and breeding place for rodents and vermin, and does NOT RETAIN ODORS.

Mechanics like to work with Infra. It is clean, FREE of dust or lint which cause ITCHING, and both during and after installation the premises are left spick-and-span, with NO particles to float down through the years and IRRITATE THE EYES AND BREATHING PASSAGES of the occupants.

FIBROUS SUBSTITUTES

Often ceilings or walls are already covered with plaster, especially in older buildings. Although Infra can easily be installed in the exposed portions, the covered parts are inaccessible, unless the plaster and lath are first removed;— which is a messy and expensive job. The usual substitute is mineral wool.

ROCKWOOL AS STANDARD

Because of its many good qualities, rockwool manufacturers have succeeded in getting rockwool accepted as the STANDARD of thermal insulation the country over. Builders often call for *"so many inches of rockwool or its equivalent"*, or *"so many inches of rockwool equivalent"*.

So Infra must perforce likewise accept "Rockwool" as the standard of measurement, which would not be so difficult were it not for the fact that probably no two brands of rockwool are alike. Some claim a *k* factor of .33, others are .50, some higher, some lower.

In their book, "Insulation", page 21, Dalzell and McKinney state:

"There are many kinds of rock and mineral wool on the market, and indications are that the number will continue to grow. The service they give in actual usage is contingent upon the type and quality of the raw materials used in manufacture, and the supervision and scientific control exercised over the manufacturing process. This is an important point, because while it is simple to produce a rock or mineral wool, it is by no means simple to produce effective insulation."

OPTIMUM VALUE

Mr. Paul D. Close in his 3d Edition of "Building Insulation", states on page 95:

"Certain types of materials have what is known as an optimum density, that is, a density which will give the minimum rate of heat flow. Any increase or decrease from this optimum value will increase the conductivity. For example, although the rate of heat transfer through rock is extremely high, the rate of heat flow through the same material in an aerated or fluffy condition (rock wool) is greatly reduced, since the density of the rock is likewise reduced. On the other hand, if such a material is fluffed up to the extent that heat is transmitted through it by radiation or convection, the heat flow will be increased. Or if the material is packed or tamped to a high density, its rate of heat flow increases as the density increases."

In Vol. 31, page 824 of *"Industrial and Engineering Chemistry"*, Dr. J. L. Finck states:

"The conductivity of limestone rock or glass ranges from 5 to 15 but is reduced to 0.3 for the wool of these materials. The bulk density is greatly reduced in the shredding process, and there is a general relation between density and conductivity for a given fibrous material. However, when material is shredded, a gas, usually air, is actually added to the bulk, and the presence of the air accounts for the reduced heat conduction."

"If the bulk density is sufficiently low, radiation will penetrate through the mass. The writer showed this effect by means of dusting fibers with powdered aluminum, with a resultant reduction in conductivity. However, as the density increases, the radiation becomes absorbed by the fibers, and beyond a certain density, radiation is negligible. We find, therefore, that for each grade of fibrous material a certain optimum density exists. For densities greater and less than this optimum density, the conductivity will increase."

An example of how Conductivity increases if density *decreases;* and how Conductivity LIKEWISE increases if density *increases;* are the specifications which the U. S. government issues to guard against densities which are too low or too high.

For instance Federal Specification HH-I-521c*, issued Oct. 10, 1946, dealing with "ROCK, SLAG or GLASS" "MINERAL-WOOL" in the form of BATTS, BLANKETS, LOOSE-FILL and GRANULAR-FILL, states:

* *Printed by Supt. of Documents, Wash., D. C. We can furnish copies on request.*

"Thermal conductivity.—The thermal conductivity of the mineral-wool insulation shall not exceed 0.33 B.t.u. per hour per square foot per degree F. temperature difference per inch of thickness at 75° F. mean temperature."

"Density.—The density of all three classes of batt insulation, including membrane facings if any, shall not exceed 6 pounds per cubic foot determined from the weight and volume."

"The density of loose-fill insulation shall not exceed 9 pounds per cubic foot."

"The density of granular-fill insulation shall not exceed 9 pounds per cubic foot."

"Oil Content.—The material shall contain not more than 0.35 percent by weight of mineral oil, asphalt, wax, or equivalent, which, if included, shall have been added while the material was being fiberized."

This specification supersedes Fed. Spec. HH-I-521b*, dated August 1937, in which for a *somewhat heavier* mineral wool, namely *"8 pounds per cubic foot"* for batts, and *"12 lbs. per cubic foot"* for loose-fill, the government requires *"The conductivity shall not exceed 0.30 B.t.u."*

While for a *still denser mineral wool, namely "12 lbs. per cubic foot"* for batts, and *"15 lbs. per cubic foot"* for loose-fill, Fed. Spec. HH-I-521b* requires *"The Conductivity shall not exceed 0.50 B.t.u."*

Packing or settling increases this density, and increases the Conductivity beyond .50. A 25% reduction of the density of a batt from 8 lbs. to 6 lbs. increased the k factor from .30 to .33.

Many batts reduce the density an ADDITIONAL 50% to *3 lbs. density per cu. ft.* Often loose wool is blown as light, or lighter.

MOISTURE-PROOFING REDUCES INSULATION VALUE

In the Jan. 1935 issue of the "Architectural Record" (*we can furnish copies*) J. L. Finck, Ph.D., wrote:

> "Any chemical which may be added to protect the fibers from moisture, or to make them fire-proof or vermin-proof, will tend to bond the fibers more or less and thus serve as a path for heat flow. Any such treatment in itself will usually reduce the insulating value of a material."

We have already seen that U. S. Federal Specification HH-I-521c calls for NOT MORE than .0035 or 1/3 of 1% of oil, asphalt or wax. A greater percentage will increase heat flow, and increase Conduction.

CONDUCTIVITIES VARY SEVERAL HUNDRED PER CENT

The *U. S. Dept. of Commerce,* National Bureau of Standards, Research Booklet 243, on *"Mechanism of Heat Flow in Fibrous Materials"* (*we can furnish copies*) tests conducted by Dr. J. L. Finck states:

> "CONDUCTIVITY MAY VARY BY SEVERAL HUNDRED PER CENT, DEPENDING ENTIRELY ON THE ARRANGEMENT OF THE FIBERS. The *maximum conductivity is obtained when the fibers are parallel to and the minimum conductivity when the fibers are perpendicular to the direction of heat flow."*

In the "Conclusions" of this Bureau of Standards booklet we find: "It may safely be said that technique is as important as the choice of raw materials in the manufacture of insulation."

On page 115, the 1947 HVA Guide states:—"Most insulating materials, except air spaces and reflective types, are of a porous nature and consist of combinations of solid matter with small air cells. The thermal Conductivity of these materials will vary with density, mean temperature, size of fibers or particles, degree and extent of bond between particles, moisture present, and the arrangement of fibers or particles within the material."

In *Paul D. Close's* book, "Building Insulation", 3d Edition, page 95, we find:

> "Certain other factors, however, such as moisture, and arrangement and character of the fibers in a fibrous material, may have a greater effect on the Conductivity than density."

For instance, AFTER fibrous insulations have been installed, if condensation is absorbed, not only does that *increase* its *immediate* Conduction, but it adds to the load and makes it more easy for the fibers to sink in and pack down, and settle.

The result is a *permanent* increase in density and Conduction, plus the creation of uninsulated spaces.

INFRA USES GOVERNMENT STANDARDS

With variations of several hundred per cent in Conductivities of mineral wool, depending on:—arrangement and character of fibers; density; quality; amount of moisture, or oil, asphalt and wax content; etc., and with *thickness* of mineral wool AT TIME OF INSTALLING often being the only specification of Conduction, regardless of whether the k factor of the rockwool is high or low,—the number of *reflective air-spaces* required to meet a specification of "so many inches of rockwool equivalent" can truthfully be based on the rockwool having the highest k factor as installed, since it is acceptable. Either two, three or four reflective spaces can meet such a specification.

HOWEVER, although some mineral wool installations are heavier than the 12 lbs. or 15 lbs. per cubic foot specified by the U. S. Government for the k factor of .50; while others as blown and fluffed, or in batt form, are lighter than the 9 lbs. or 6 lbs. called for by the government for a k factor of .33, in fact as low as 3 lbs. per cu. ft.; Infra is using k .33 and k .50 as the STANDARDS of MEASUREMENT for the values of its Accordion and Crinkle Insulations.

**Printed by Supt. of Documents, Wash., D. C. We can furnish copies on request.*

CRINKLE INSULATION

RECOMMENDED: For PANELS. Also for LAYING in floors BETWEEN JOISTS, or on overhung ceilings, or over steel or concrete beams; and for STAPLING between joists or studs in ceilings, walls and floors. Has outer reflective surface and also contains innumerable inner reflective air-cells. Foundation is either *K*RAFT, "K" line; or *A*SBESTOS "A" line.

TYPES 2KR, 2AR CRINKLE: Tough .0007" thick crinkled aluminum mounted on 60 lb. flame, mold and vermin proof KRAFT; or ASBESTOS. Outer reflective surface is 95% efficient in outer reflective air-space; plus innumerable inner reflective air-spaces and reflective surfaces. Is narrow enough to Roll and LAY between joists.

TYPES 2KS, 2AS, CRINKLE: Same as 2KR and 2AR, except 3" wider for *S*tapling.

TYPE 3KR, CRINKLE: Aluminum same as in 2KR. KRAFT foundation has aluminum laminated to outer surface, which provides a 3d 95% efficient reflective surface and a third reflective air-space.

TYPE 3KLR CRINKLE: *Recommended* where foil is exposed. Can withstand ABUSIVE handling and VIBRATIONS. Same as 3KR, except that Crinkled aluminum consists of 2 foils reinforced with central core of paper lamination.

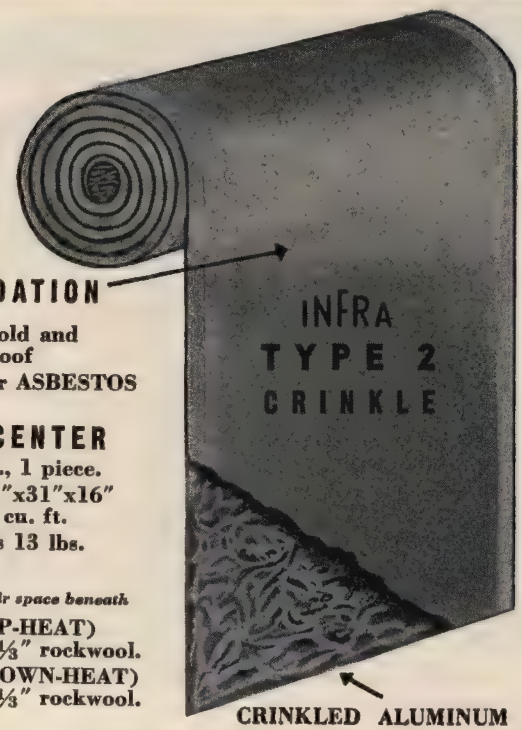
HOW TO INSTALL CRINKLE INSULATION

Crinkle Insulation is stapled or nailed to panels, beams, or studs, through flanges along both sides of the insulation. For best results, provide air spaces for *both* outer surfaces.

It can be LAID by merely rolling out on bottom of floor or panel, (not too tightly). When laid; Type 2 Crinkle gives best results with FLAT surface DOWN; Type 3 Crinkle with CRINKLE surface DOWN.

When STAPLED with an air space each side: — with Type 3 either surface can face the heat; but with Type 2 it is preferable that the aluminum surface should face the heat.

For cutting or fitting, use snips or heavy shears.



FOUNDATION

Flame, mold and vermin-proof KRAFT or ASBESTOS

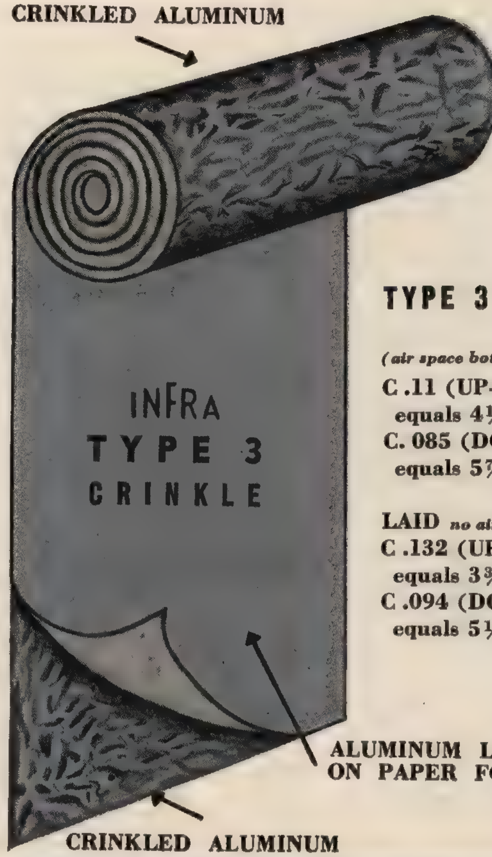
16" CENTER

200 sq. ft., 1 piece.
Carton 31"x31"x16" equals 9 cu. ft.
2K weighs 13 lbs.

LAID ***no air space beneath***
C .151 (UP-HEAT) equals 3⅓" rockwool.
C .115 (DOWN-HEAT) equals 4⅓" rockwool.

CRINKLED ALUMINUM

CRINKLED ALUMINUM



TYPE 3 CRINKLE

(air space both outer surfaces)
C .11 (UP-HEAT) equals 4½" rockwool.
C. 085 (DOWN-HEAT) equals 5⅞" rockwool.

LAID ***no air space beneath***
C .132 (UP-HEAT) equals 3¾" rockwool.
C .094 (DOWN-HEAT) equals 5⅓" rockwool.

ALUMINUM LAMINATION ON PAPER FOUNDATION

CRINKLED ALUMINUM

SOME TYPICAL INFRA PROJECTS

PRINCETON UNIVERSITY, N. J., July 1946.
New York Life Insurance Co., *owner,* 152 units.
Holden, McLaughlin & Assoc. *architects,* Wm. L. Crow Constr. Co., *Bldrs.*

COLBY COLLEGE, Waterville, Maine, June 1946.
Hegeman-Harris Co., *builders—engineers.* Jens F. Larson, *architect.*
Chapel, Library, Memorial Hall, Dormitories.

PHILADELPHIA-BOULEVARD APTS. Jan. 1947.
Metropolitan Life Insurance Co. project. Edward Pearl, *builder.*

PURDUE UNIVERSITY, Lafayette, Indiana, May 1946. Students Housing Project.

U.N.O. APARTMENT HOUSING, for families of United Nations' officials. Great Neck, L. I. 1946
S. Atlas, Welwyn Realty Corp., *builder.* M. Exerjian, *architect.*

MASS. INSTITUTE of TECHNOLOGY, Cambridge, Jan. 1946.
Students Housing. 250,000 sq. ft. of Infra in 250 cartons were loaded on 1 truck in TWO HOURS, and delivered on the job several hours later. Rockwool would have required loading and carting 6,250 bulky, heavy boxes on 25 truckloads to 12 railroads cars, reloading 25 trucks, unloading at the project, and employing a large crew for weeks just to distribute it.

PROJECT	BUILDER, ARCHITECT, etc.
Bowdoin College, Brunswick, Maine	*Dept. of Physics*
Brighton Manor Homes, Brooklyn, N. Y.	*H. & S. Waxman*
Westover Field, Chicopee Falls, Mass.	*Ley Construction Co.*
Trump Housing, Cropsey Ave., Bklyn.	*Fred Trump*
Prefabricated Homes, Ellaville, Ga.	*Georgia Con. Contr. Co.*
Ford Factory Built Homes, Palatka, Fla.	*J. W. Campbell*
Crown-Zellerbach Paper Co., Los Angeles	*R.W. Downer Co.*
Southern Calif. Edison Co., Alhambra	*Forrest Lundstrom Co.*
Chestnut Gardens, Bridgeport, Conn.	*S. Bernstein*
Prefabricated Homes, Marietta, Ga.	*U. S. Homes, Inc.*
Garrison & Stuart Aves., Brooklyn, N. Y.	*Stanley Builders*
Bayside Hills, Bayside, L. I.	*Morris Weinberger*
Rossbach Homes, Flushing, L. I.	*Robert Podgur*
College Const., Flushing, L. I.	*Henry Minskoff*
Prefabricated Bldgs., Bridgeport, Conn.	*City Lumber Co.*
Westacres, Pontiac, Mich.	*Oakland Housing Inc.*
Prefabricated Homes, Janesville, Wis.	*Midwest Housing Corp.*
Prefabricated Homes, Stockton, Cal.	*Precision Homes Co.*
International Braid Co., Prov., R. I.	*A. J. Puschin, Engineer*
I. H. Smith Res., Jacksonville, Fla.,	*Reynolds, Smith & Hills, Arch.*
Old California, Eastchester, N. Y.	*Baltz Construction Co.*
Rye Hills, Rye, N. Y.	*Frank Doria*
Comm'l. Decal. Factory, Mt. Vernon, N. Y.	*Cuzzi Bros. & Singer*
Wm. L. Bottomley (Arch) Res., Cold Spring	*Stiles Bldg. Corp.*
Atlantic Beach Homes, L. I.	*Blumenthal & Schusheim*
Silver Fox Tavern, Wash., D. C.	*Lee J. Turner*
Atlantic & 3rd St., S.E., Wash., D. C.	*Michael Sesso & Co.*
Housing Project, S.E., Wash., D. C.	*V. Innamorato*
Veterans Housing, Arlington, Va.	*Gordon Const. Ass.*
Food Plant, Brentwood, Md.	*Eisen Constr. Co.*
Llanarch Project, Del. Co., Penn.	*Philip A. J. Ienni*
American Type Foundry, Atlanta, Ga.,	*M. Fowler*
Georgian Autotel, Atlanta, Ga.	*McKenney & Fitts*
E. Atlanta Sub-Division, Atlanta, Ga.	*J. D. Venable*
Clairmont Road Homes, Atlanta, Ga.	*DeKalb Builders*
Beverly Rd., N. W., Atlanta, Ga.,	*Allen Wesley*
Techwood Dr., N. W., Atlanta Ga.	*Norris Construction Co.*
Dial Bilt Homes, Inc., Bronx, N. Y. C.	*S. J. Olshin*
Alanwood Corp., White Plains, N. Y.	*Alan L. Carnoy*

PROJECT	BUILDER, ARCHITECT, etc.
1st Bldrs. Corp., Astoria, L. I.	*Ben Hess*
Crossroads Constr. Co., Oceanside, L. I.	*E. Austern*
South Bay Constr. Corp., Copiague, L. I.	*Wm. S. Friedland*
Veteran's Constr. Ass'n., Locust Valley, L. I.	*Yale Adelson*
F. U. Realty Co., Union, N. J.	*Frank Umanetz*
Prefabricated Homes, McDonough, N. Y.	*Ivan R. Ford*
Kenilworth Drive, Akron, Ohio	*J. E. Jansen*
Edward Lowe Res., Eastchester, N. Y.,	*Lawrence M. Loeb, Arch.*
Mech. Arts High School, New Rochelle, N. Y.,	*L. H. Lyon, Arch.*
Model Home, New Rochelle, N. Y.,	*Leland H. Lyon, Architect*
Flower Hill Bldg. Corp., Sands Point, L. I.	*Harold Uhl*
Stephany Homes, Hicksville, L. I.	*George S. Orr*
Butler Bros., Lumber, 201 St., N. Y. C.	*J. Friedman*
Model Home, Larchmont, N. Y.	*Paul C. Weber*
Paddy's Grill, Long Beach, L. I.	*Chas. White*
Prospect Heights Apts., Staten Island	*Godfrey Weinstein*
Architect's Residence, Jacksonville, Fla.	*Walter B. Schultz, Arch.*
Research Bldrs., No. Bergen, N. J.	*Leon H. Katz*
Liberty Ave., Hillside, N. J.	*P. Arlauckas*
Warren Portahome Co., Mays Landing, N. J.,	*John T. Warren, Jr.*
T. & H. Constr. Co., Long Beach, L. I.	*Max Hirsch*
A. Sidney Roth, Long Beach, L. I.,	*Julius Rapson, Architect*
Melinger Proj., Huntington, L. I.	*H. H. Gutheil*
Mohegan Park Dev., Yonkers, N. Y.	*Wm. Farrell*
Palatial Homes Inc., Elmhurst, L. I.	*David D. Greene*
Remsen Avenue Project, Brooklyn, N. Y.	*Chizner & Smith*
Knickman Homes, Queens Village, L. I.	*Miller & Gutterman*
Rosemont Const. Co., Union, N. J.	*Portnoff Bros.*
Beekman Hill Homes, St. Albans, L. I.	*Levinson & Furmovitz*
Batgood Homes, Rockaway, L. I.	*G. M. Schwartz*
Modernage Homes, Jackson Heights, L. I.	*J. G. Miller*
Norman Homes, Mamaroneck, N. Y.	*Irving A. Lipsig*
Park Ave. Res., Long Beach, L. I.	*George Davy*
T. & H. Constr., Long Beach, L. I.	*A. Treib & M. Haile*
Gus Pinelli, Bronx, N. Y.	*Fred J. Ross, Arch.*
Feldman Lumber Co., Brooklyn, N. Y.	*M. Feldman*
19th St. Project, Astoria, L. I.	*John Pinizzotto*
Demont Homes, 85 St., Brooklyn,	*L. Montegnino*
Wayne Bldg. Corp., E. 45th St., Brooklyn	*I. Kallich, Arch.*

NOTES ON
THERMAL INSULATION CHART

A reference chart (see following page) contributed by Infra for use of architects, engineers, builders, supply houses, applicators and home owners.

k factor, or Conductivity:— is the amount of heat flow (or heat loss) in B.t.u. in one hour through one sq. ft. area of ONE INCH THICKNESS of any homogeneous material for a 1°F. temperature difference between its 2 surfaces. (k factor is not applicable to reflective insulation).

C factor, or Conductance:—is the rate of such heat flow in B.t.u. in one hour through one sq. ft. area of the ENTIRE THICKNESS of any material, whether more or less than 1".

U factor is rate of such heat flow, or "overall coefficient or heat transmission" in B.t.u. in one hour through one sq. ft. area of entire ceiling and roof, wall, or floor structure, including insulation if any.

(The *smaller* the *k, C,* or *U* factor fraction, and the larger the R factor, the BETTER it is as insulation).

R factor or Resistance to heat flow:—is reciprocal of k, C, or U.

Thermal factors of their products, published by manufacturers, have INVARIABLY been ACCEPTED and incorporated in this Chart. The small letters denote which factor the Authority has determined and the manufacturer has published; and the Authority's name is printed below. The remaining thermal factors were derived by computation, using the Authoritative factor as the base.

There has been no consideration given in this chart to increases in thermal values of fibrous insulations with the lapse of time, due:—to added moisture; to increased density because of packing caused by its own weight, vibrations, and condensation or other moisture; to spaces that become uninsulated because of settling. Nor has any consideration been given to increases or decreases in their densities, caused by handling, cartage, method of installing, etc.

In the case of fibrous products, thermal factors do not vary because of direction of heat flow, excepting if density is so low (fluffed up) that convection currents or radiation can penetrate.

For CEILINGS and ROOFS without flooring, heat flow *up,* WITHOUT INSULATION, the various Resistance factors are as follows:—Outside air (15 mile) .17; tar roof .75; ⅞" roof board 1.25; air space .76; ⅜" gyp lath on ½" plaster .42; inside surface .51. Total Resistance is 3.86, and the U factor is .259.

For CEILINGS and ROOFS without flooring, with heat flow DOWN, inside air surface R is .83; and each air space R is 1.06. Total R is 4.48 and U is .223.

For WALL, WITHOUT INSULATION, the various Resistance factors are:—Outside air (15 mile) .17; clap board .78; sheathing paper .18; 25/32" fiberboard sheathing 2.37; air space .91; ½" plaster on ⅜" gyp lath .42; inside air surface .61. The total Resistance is 5.44, and the U factor is .183.

For FLOOR, heat flow DOWN, WITHOUT INSULATION, the R factors are:—Inside surface .83; 13/16" hard wood floor .71; sheathing paper .18; 25/32" Y.P. sub-flooring .98; air surface below .83. Total Resistance 3.53. U = .28.

When computing ceiling and wall U factors with Infra and other reflective insulations, the Resistance of one ordinary air space was first DEDUCTED from the Resistance of the above U factors. A similar deduction should likewise be made in the case of fibrous insulations when they completely fill an air space which has been computed. With floor insulation, the *air surface below* of R .83 was deducted when computing Infra U factors.

Thermal values of Infra Insulation were determined at Armour Research Foundation of Illinois Institute of Technology by I. B. Fieldhouse and Norman C. Penfold, also by Dr. J. L. Finck, Physicist and Specialist on Heat Insulation; of Finck Laboratories, New York City; formerly with the National Bureau of Standards, Heat Transfer Section, Washington, D. C. We can furnish detailed laboratory reports on request.

CHART

THERMAL INSULATION VALUES

(Explanatory notes on page 15)

LOCATION and POSITION of INSULATION	DIRECTION OF HEAT FLOW	ROCKWOOL EQUIVALENTS k.50	ROCKWOOL EQUIVALENTS k.33	1000 SQ. FT. WEIGHT LBS.	1000 SQ. FT. STORAGE CU. FT.	C Factor	R Factor	U Factor (CEILINGS and roofs with unfloored attics; WALLS; FLOORS)
Infra TYPE 4 Accordion								
Horizontal (ceiling)	UP (winter)	6"	3.97"	58	3	.083*i*	12.04	.066
Horizontal (ceiling)	DOWN (summer)	9⅗"	6⅓"	58	3	.052*i*	19.23	.044
Horizontal (floor)	DOWN (winter)	9¾"	6⅓"	58	3	.052*i*	19.23	.045
Vertical (wall)	Lateral	5"	3⅓"	58	3	.10*a*	10.00	.064
Infra TYPE 2 Accordion								
Horizontal (ceiling)	UP (winter)	4⅓"	2⅞"	60	3	.114*a*	8.77	.084
Horizontal (ceiling)	DOWN (summer)	6"	4"	60	3	.082*a*	12.19	.064
Horizontal (floor)	DOWN (winter)	6"	4"	60	3	.082*a*	12.19	.067
Vertical (wall)	Lateral	4"	2½"	60	3	.128*a*	7.81	.081
Infra TYPE 3 Crinkle *(Air space both outer surfaces)*								
Horizontal (ceiling)	UP (winter)	4½"	3"	65	45	.110*a*	9.09	.082
Horizontal (ceiling)	DOWN (summer)	5⅞"	3⅞"	65	45	.085*a*	11.76	.065
Horizontal (floor)	DOWN (winter)	5⅞"	3⅞"	65	45	.085*a*	11.76	.069
Infra TYPE 3 Crinkle *(No air space underneath)*	LAID							
Horizontal (ceiling)	UP (winter)	3¾"	2½"	65	45	.132*a*	7.57	.093
Horizontal (ceiling)	DOWN (summer)	5⅓"	3½"	65	45	.094*a*	10.64	.071
Horizontal (floor)	DOWN (winter)	5⅓"	3½"	65	45	.094*a*	10.64	.074
Infra TYPE 2 Crinkle *(No air space underneath)*	LAID							
Horizontal (ceiling)	UP (winter)	3⅓"	2⅕"	60	45	.151*a*	6.66	.102
Horizontal (ceiling)	DOWN (summer)	4⅓"	2⅞"	60	45	.115*a*	8.69	.082
Horizontal (floor)	DOWN (winter)	4⅓"	2⅞"	60	45	.115*a*	8.69	.087

MINERAL WOOL	Batts or Blankets DENSITY	Loose-Fill and Granular DENSITY	k Factor	THICK	1000 SQ. FT. Weight Lbs.	1000 SQ. FT. Storage Cu. Ft.	C Factor	R Factor	U Factor (CEILINGS and roofs with unfloored attics)
Rock, Slag or Glass. Laboratory-Dry.	6 lbs.	9 lbs.	.33*b*	1"	750	—	.33	3.03	.145
Not over .0035 oil content.	12 lbs.	15 lbs.	.50*c*	1"	1250	—	.50	2.00	.17
Standard full-thick mineral wool blankets are	6 lbs.	9 lbs.	.33*b*	2"	1500	117	.165	6.06	.10
3" thick.	12 lbs.	15 lbs.	.50*c*	2"	2500	117	.25	4.00	.127
(4" thick not made.)	6 lbs.	9 lbs.	.33*b*	3"	2250	175	.11	9.09	.077
	12 lbs.	15 lbs.	.50*c*	3"	3750	175	.166	6.00	.101
WOOD FIBERS between paper, "Standard"			.25*d*	9/10"	301	78	.277	3.60	.134
WOOD FIBERS between paper, "Double-thick"			.25*d*	1¾"	602	156	.142	7.00	.092
SAWDUST			.41*e*	1"	1000	—	.41	2.44	.158
CREPED AND STITCHED, expanding fibrous blanket			.27*d*	1"	127	14	.27	3.70	.133
			.27*d*	2"	231	28	.135	7.40	.088
CORKBOARD			.32*e*	1"	1166	—	.32	3.12	.143
FIBRE BOARD			.33*d*	½"	625	—	.662	1.51	.186
			.33*d*	1"	1250	—	.33	3.03	.145
BRICK			5.00*f*	8"	—	—	.625	1.60	—
WOOD, LATH AND PLASTER, total thickness ¾"			—	¾"	—	—	2.50*g*	.40	—
PURE ALUMINUM FOIL, laminated to BOTH sides of 1 sheet of paper, when installed in mid-space, with TWO reflective surfaces and TWO reflective air-spaces.					UP HEAT		.27*h*	3.70	.147
SILVER OR ALUMINUM COLORED SUBSTANCE coated to BOTH sides of 1 sheet of strong building paper. When installed in mid-space, with 2 reflective surfaces, and with TWO reflective air spaces.					UP HEAT		.40*h*	2.50	.178
When in direct contact with ceiling, leaving 1 reflective space...........					UP HEAT		.80*h*	1.25	.22
2 FOILS *aluminum* 1" apart, vapor paper 1" beneath; midspaced.					UP HEAT		.145	6.90	.099h

ROCKWOOL EQUIVALENTS k.33	ROCKWOOL EQUIVALENTS k.50
2½"	3½"

a. J. L. Finck — *b. U. S. Federal Specification HH-I-521c* — *c. U. S. Federal Specification HH-I-521b*
d. J. C. Peebles — *e. U. S. Bureau of Standards* — *f. A. C. Willard et al.*
g. F. B. Rowley et al. — *h. G. B. Wilkes* — *i. Armour Research Foundation*

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